



This application is based on Patent Application No. 2001-063994 filed March 7, 2001 in Japan, the content of which is incorporated hereinto by reference.

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## BACKGROUND OF THE INVENTION

### FIELD OF THE INVENTION

10       The present invention relates to an IC socket used for inspecting IC packages in a semiconductor device manufacturing process and more particularly to an open top type IC socket which has a socket body and a cover member attached vertically movable to the  
15       socket body to open and close contacts.

### DESCRIPTION OF THE RELATED ART

20       In this kind of conventional IC sockets, to efficiently mount and position mass-produced IC packages in an IC socket by using a robot, it is conventional practice to provide a socket body with inclined guide walls that restrict and guide movement of an IC package or to form guide posts projecting at  
25       corners of the socket body and guide the IC package with its lead terminals being in contact with the guide posts.

In the conventional IC socket of a type having the inclined guide walls on the socket body, however, the assembly into the socket body of a plurality of contacts, which are to be connected with the lead terminals of an IC package, is not easy as it is hindered by the inclined guide wall rising above the contacts, thus increasing the number of assembly steps.

On the other hand, in a type having guide posts projecting at corners of the socket body, since the lead terminals contacting the guide posts are limited to those present at the corners of the IC package, a load bears on only the contacting lead terminals, giving rise to a possibility of these lead terminals being deformed.

Another drawback is that the projecting guide posts become hindrance and limit the moving path of the robot when the robot holds the IC package by suction and mounts it on the IC socket.

#### SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an IC socket which can solve the above-described problem and which can facilitate automatic mounting of an IC package without fear of lead terminal deformation and reduce the number of steps in assembling the contacts into the socket body.

In the first aspect of the present invention,  
there is provided an open top type IC socket  
comprising:

a socket body; and

5 a cover member mounted vertically movable to the  
socket body to open and close contacts;

wherein the socket body has a mounting portion to  
support an IC package mounted on the socket, and the  
cover member has a square opening facing the mounting  
10 portion and inclined guide wall surfaces leading to  
the opening and adapted to guide the IC package to be  
mounted onto the mounting portion.

Here, at least two opposing sides of the opening  
substantially may match with an envelope joining tips  
15 of lead terminals extending from the IC package to be  
mounted.

The inclined guide wall surfaces may be arranged  
symmetrical with respect to longitudinal and lateral  
center lines of the square opening and each may  
20 comprise a first inclined guide wall surface  
traversing each of the center lines, a second inclined  
guide wall surface provided at each corner portion and  
having an inclination angle larger than an inclination  
angle of the first inclined guide wall surface, and a  
25 third inclined guide wall surface connecting to the  
first and second inclined guide wall surfaces.

A plurality of fixed contacts may be arranged

around the mounting portion and two opposing sides of the opening substantially may match with an envelope joining outer ends of the fixed contacts.

In the second aspect of the present invention,  
5 there is provided an IC socket comprising:

a socket body having a mounting portion for supporting an IC package and a plurality of contacts arranged around the mounting portion to come into contact with tips of lead terminals extending from the  
10 IC package; and

a cover member having an opening at a center thereof and mounted vertically movable to the socket body to open and close the contacts;

wherein the opening has its lower edge formed  
15 into a square facing the mounting portion and has inclined guide wall surfaces for guiding the IC package onto the mounting portion.

Here, the contacts each may have a base portion embedded in the socket body, a first arm extending  
20 from the base portion and having a first contact at its tip, and a second arm extending from the base portion and having a second contact at its tip and a curved elastic portion at its intermediate portion.

The first contacts at the tips of the first arms  
25 may be secured to the socket body.

Two opposing sides of the opening may almost match with an envelope joining outer ends of the first

contacts of the first arms of the contacts.

At least two opposing sides of the opening may almost match with an envelope joining tips of lead terminals extending from the IC package.

5           The inclined guide wall surfaces may be arranged symmetrical with respect to longitudinal and lateral center lines of the square opening and each may comprise a first inclined guide wall surface crossing each of the center lines, a second inclined guide wall surface provided at each corner portion and having an inclination angle larger than an inclination angle of the first inclined guide wall surface, and a third inclined guide wall surface connecting to the first and second inclined guide wall surfaces.

10           The contacts each may have a base portion embedded in the socket body, a first arm extending from the base portion and having a first contact at its tip, and a second arm extending from the base portion and having a second contact at its tip and a curved elastic portion at its intermediate portion.

15           The first contacts at the tips of the first arms may be secured to the socket body.

20           Two opposing sides of the opening may almost match with an envelope joining outer ends of the first contacts of the first arms of the contacts.

25           At least two opposing sides of the opening may almost match with an envelope joining tips of lead

terminals extending from the IC package.

The above and other objects, effects, features and advantages of the present invention will become more apparent from the following description of  
5 embodiments thereof taken in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

10 Fig. 1 is a plan view showing one embodiment of an IC socket according to the present invention;

Fig. 2 is a cross section of the IC socket taken along the center line Xo of Fig. 1;

15 Fig. 3 is a cross section of a cover member of the IC socket according to the present invention taken along the center line Xo of Fig. 1;

Fig. 4 is an enlarged partial perspective view of the cover member of the IC socket according to the present invention; and

20 Fig. 5 is the same plan view as Fig. 1 of the IC socket according to the present invention, showing an example of how an IC package is guided.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

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Now, a preferred embodiment of the present invention will be described by referring to the

accompanying drawings.

As shown in Fig. 1 to Fig. 4, an IC socket 10 according to one embodiment of this invention is a so-called open top type IC socket which generally has a socket body 100 and a cover member 200 mounted  
5 vertically movable on the socket body 100 to open and close contacts described later.

The socket body 100 includes a socket base 110 formed from an insulating substrate, square in plan  
10 view, in which a plurality of contacts 120 are arrayed along each of its four sides. A mount 130, square in plan view, is positioned at a central portion of the socket base 110 and press-fitted to it. A positioning seat 140, also square in plan view but slightly  
15 smaller than the mount 130, is removably provided on the top of the mount 130. The positioning seat 140 constitutes a mounting portion for supporting an IC package 300 mounted on the IC socket 10 and supports a resin body 310 of the IC package 300 with positioning  
20 projections 142 protruding from the positioning seat 140 at its four corners. More specifically, at each corner paired positioning projections 142 are arranged perpendicular to each other and engage perpendicularly intersecting corner inclined surfaces of the body 310  
25 of the IC package 300 to support the IC package 300.

The contacts 120 in this embodiment are of a so-called two-contact type having two contacts each. The



contacts 120 are each formed of a conductive material and have a base portion 122 embedded in the socket base 110, a first arm 124 and a second arm 126 extending from the base portion 122, and an operation lever 128 connected to the second arm 126, all integrally formed by punching. The first arm 124 integrally has a first contact 125 at its end and the second arm 126 integrally has a second contact 127 at its end. The second arm 126 has its intermediate portion formed into a curved elastic portion 129. The first contacts 125 are arranged on an upper surface periphery of the mount 130 along the sides of the positioning seat 140.

The socket base 110 has arranged outside the periphery of the mounting portion a large number of slits, which are the same in number and pitch as the contacts 120 and lead terminals 320 of the IC package 300. The slits receive the first and second arms 124, 126 and guide the second arm 126 as it moves.

Next, the cover member 200 has an opening 210 square in plan view and facing the mounting portion and inclined guide wall surfaces 220 leading to the opening 210 and adapted to guide the IC package 300 onto the mounting portion. The opening 210 is so sized that two opposing sides of the opening 210 almost match with an envelope joining tips of the lead terminals 320 extending from the two opposing sides of

the IC package 300. In this embodiment, the lead terminals 320 extend from four sides of the IC package 300 and thus the lower edges of the four sides of the opening 210 almost match with the envelope joining the tips of the lead terminals 320. For an IC package with its lead terminals extending from only two opposing sides, the size of the opening need only be set so that the lower edges of the corresponding two opposing sides of the opening almost match with the envelope joining the tips of the lead terminals 320.

Further, on the outer periphery of the positioning seat 140 that constitutes the mounting portion, a plurality of first contacts 125 as fixed contacts are arranged. The size of the opening is also set so that the lower edges of the two opposing sides of the opening 210 almost match with an envelope joining outer ends of the first contacts 125.

The inclined guide wall surfaces 220 in the cover member 200 are arranged symmetrical with respect to the longitudinal and lateral center lines  $X_o$  and  $Y_o$  of the square opening 210. The inclined guide wall surfaces 220 traverse the center line  $X_o$  or  $Y_o$  and each have a first inclined guide wall surface 222 inclined at an angle  $\theta_1$  to a vertical surface containing a center line  $Z_o$  perpendicular to the longitudinal and lateral center lines  $X_o$  and  $Y_o$  and one of the longitudinal and lateral center lines  $X_o$

and Yo, a second inclined guide wall surface 224 provided at each corner portion and having an inclination angle  $\theta_2$  larger than the inclination angle  $\theta_1$  of the first inclined guide wall surface, and a  
5 third inclined guide wall surface 226 connecting to the first and second inclined guide wall surfaces 222 and 224. Since the third inclined guide wall surface 226 connects to both of the first and second inclined guide wall surfaces 222 and 224 having different  
10 inclination angles, it forms a composite inclined surface which recedes from  $\theta_1$  to  $\theta_2$  in inclination angle with respect to the vertical surface with a predetermined escape angle  $\beta$  as the viewing point moves from the center line Xo or Yo toward each corner.

15 An underside of the cover member 200 is formed with inclined cam surfaces 230 that engage with the operation lever 128. Guide claws 240 extend downward from the cover member 200, as shown in Fig. 3, to allow the cover member 200 to be vertically movably  
20 mounted on the socket body 100.

In the IC socket 10 of the embodiment above, when the cover member 200 is pressed against the socket body 100 from above by a robot arm not shown, the operation levers 128 engaging with the inclined cam  
25 surfaces 230 are moved against the spring force of the curved elastic portions 129 of the second arms 126, parting the second contacts 127 of the second arms 126

from the first contacts 125 of the first arms 124. In that state, when the IC package 300 that was held by suction with a robot arm or the like is released, the IC package 300 falls onto the IC socket 10, as

5 indicated by arrow of Fig. 2.

When during the fall the IC package 300 is deviated to one side or inclined with respect to the center line  $Z_0$  of the IC socket 10, the tips of the lead terminals 320 of the IC package 300 first abut  
10 with and are guided by the first inclined guide wall surface 222 of the inclined guide wall surface 220 on that side toward which the IC package 300 is deviated. Then, the tips of the lead terminals 320 on the  
15 opposite side abut with and are guided by the first inclined guide wall surface 222 on the opposite side. As a result, the IC package 300 is supported on the positioning seat 140, with the corner inclined surfaces of the IC package body 310 abutting against the positioning projections 142.

20 The inclined guide wall surfaces 220 lead to the opening 210, and each side of the opening 210 almost agrees with an envelope joining the tips of the lead terminals 320 extending from the IC package 300 to be mounted on the socket and also with an envelope  
25 joining the outer ends of the first contacts 125. Hence, the IC package 300 that has been engaged and guided by the first inclined guide wall surfaces 222

is now supported on the positioning seat 140 with the corner inclined surfaces of its body 310 abutting against the positioning projections 142 and with the lead terminals 320 precisely positioned on the first contacts 125.

When on the other hand the IC package 300 is about to be fitted onto the positioning seat 140 in a deviated and rotated state with respect to the center line  $Z_0$  but with no inclination to the horizontal plane, as shown in Fig. 5, the tips of the lead terminals 320 of the IC package 300 at the corner portions abut with the third inclined guide wall surfaces 226 and are guided diagonally downward along the third inclined guide wall surfaces 226 toward the center line  $Z_0$ , causing the IC package 300 to rotate in the horizontal plane. As a result, the IC package 300 is now guided by the first inclined guide wall surfaces 222 in a manner described above until it is supported on the positioning seat 140 with the corner inclined surfaces of the IC package body 310 abutting against the positioning projections 142 and with the lead terminals 320 precisely positioned on the first contacts 125.

Then, when the robot arm is retracted upward to free the cover member 200 from the pressing force, the spring force of the curved elastic portions 129 of the second arms 126 pushes up the cover member 200 and at

the same time causes the second contacts 127 of the second arms 126 to bear against, from above, the lead terminals 320 of the IC package 300 on the first contacts 125 of the first arms 124 thereby clamping  
5 the lead terminals 320 between the first contacts 125 and the second contacts 127.

Although in the above embodiment the IC package is positioned by using the guiding action between the tips of the lead terminals extending from the four  
10 sides of the IC package and the inclined guide wall surfaces, it is needless to say that in the IC packages having the lead terminals on only two sides, the guiding action on the two sides having no lead terminals need only be produced by the engagement  
15 between the side surfaces of the IC package body and the inclined guide wall surfaces.

Further, while the two-contact type IC socket having the first and second contact arms have been described above, the present invention is also  
20 applicable to a so-called one-contact type IC socket having only one arm for each contact.

As can be seen from the above description, because in this invention the cover member has the square opening facing the mounting portion and the  
25 inclined guide wall surfaces leading to the opening and guiding the IC package onto the mounting portion, there are no inclined guide walls extending above the

contacts, which in turn facilitates the assembly of the contacts into the socket body. Further, since there is no need to provide projecting guide posts at the corners of the socket body, it is possible to  
5 prevent deformations of the lead terminals that would otherwise be caused by a load bearing on only those lead terminals present at the corners of the IC package. Further, because there are no guide posts, the moving path of the robot is not limited, allowing  
10 the mounting of the IC package to be performed with ease and in a short time.

The present invention has been described in detail with respect to preferred embodiments, and it will now be apparent from the foregoing to those  
15 skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and it is the intention, therefore, in the appended claims to cover all such changes and modifications as fall within the true spirit of the  
20 invention.